

AMENDMENTS TO THE SPECIFICATION

On page 12, please amend the paragraph beginning on line 1 and ending on line 11 as follows:

UV tube 20 must be mounted close to burner 10 in what is sometimes referred to as a scanner. The series connected quench circuit is preferable to the commonly used parallel connected quench circuit. The large capacity (.002 μ f) of the series circuit permits the circuit to be physically spaced from the scanner without effecting the quench time constant. A typical parallel connected quench circuit has a capacitor of the order of 200 pf and a resistor of 10 meg Ω . The parallel quench circuit cannot be spaced from the scanner because the wiring capacitance would undesirably increase the time constant. Thus, with a parallel circuit the scanner must either be a 3 wire device with a weak output pulse that cannot be conducted, even with a shielded cable, more than a short distance; or the scanner, power supply and detector circuit must all be an integral assembly mounted together at the burner. Both of these approaches are undesirable as they require sensitive circuitry to be operated in a hot, hostile environment.

On page 12, please amend the paragraphs beginning on line 17 and ending on page 13, line 17 as follows:

The pulses in the anode/cathode circuit of the ultraviolet tube 20 are coupled by opto 1 to FDCP 30. The signal at TP 1 is illustrated at 51, Fig. 5 for the nominal pulse frequency of 250 hz. Each pulse has a duration of 0.5 μ sec and an amplitude of 18 volts. Each pulse turns Q4 on discharging C9 (.22 μ f) which charges again through R8 (1.5 meg Ω) between pulses. The

voltage at TP2, across C9 is shown at 52. The frequency at TP2 is a maximum. The charge and discharge of C9 are as “square” as possible. Q5 is turned off with each pulse and conducts again as C9 charges. V_{be} of Q5 is reached at about 63% of the RC time of R8, C9. When Q5 is turned off, C12 (.22 μ f) charges through R11 (47K Ω). When Q5 conducts again, C12 discharges through opto LED 2. At 250 hz, Q5 switches at its maximum frequency and efficiency. The power to opto LED 2 is at a maximum. The voltage at TP3, across Q5 and C12 in series with the combination of D7 and opto LED 2, is shown at 53. The voltage at TP4 across D7 and opto LED 2 is shown at 54. The pulse frequency at TP4 is approximately 1/10th the pulse frequency at TP1.

Opto LED 2 causes opto transistor 2 and Q8 to conduct with each negative pulse 54. At the end of each pulse, the collapse of current in the primary winding of transformer T2 induces a flyback voltage in the secondary winding which is rectified by diode D10 to charge three capacitors C18, C19, C20. The charge on the three capacitors then drains through terminal E and the current detector amplifier ~~38~~ 33 of the combustion safeguard, Fig. 4 simulating the current from a flame rod. Fuel control relay 35 is energized closing contact F1 and opening fuel control valve 14. The three capacitors are used so that if one or even two fail, the circuit is still operative. ~~Three~~ The three capacitors also control the flame failure response time (FFRT) of the combustion safeguard. The combustion safeguard applies a high AC voltage, e.g., 390 volts AC, to the E terminal. R29, 10 meg Ω , limits the AC leakage current so that the combustion safeguard is not actuated by it.

Page 14, please amend the paragraphs starting on line 4 and ending on page 15, line 11 as follows:

With a no flame condition, the pulse signal from UV tube 20, as from noise, for example, is less than 10 hz. The signals at TP 1 and TP 2 are shown at 62 and 63, Fig. 4 5. The charge developed on C12 is insufficient to establish an output current from CPFS which will meet the current threshold of the combustion safeguard. The signals at TP 3 and TP 4 are shown at 64 and 65. Thus, the FDCP 30 distinguishes between the flame responsive desired pulse signal and undesired pulse signals and the CPFS 31 and combustion safeguard circuits control the fuel valve in response to the FDCP output signal.

A visual display of the pulse signal frequency in the UV tube cathode/anode circuit is provided by signal LED 67 in a relative signal indicator (RSI) circuit 68. Transistor Q10 is normally conducting and is turned off when its base is grounded by conduction of either Q8 or Q9. Q8 conducts when TP4 goes high. Q9 conducts when TP1 goes high. When Q10 is off, TP5 is high and current flows through R20, D11 and R21 to charge capacitor C15 which is connected with the anode of programmed unijunction transistor PT1, 2N6027. The trigger voltage of the gate of PUT1 is established by the voltage divider R24, R25. When PUT1 avalanches, Q11 conducts and signal LED67 is energized. As the energy of C16 is exhausted, PUT 1 turns off. R23 and C16 are selected for a signal duration of the order of 200 milliseconds with a smooth ramp up and ramp down. The flashes of LED 67 provide a rough indication of the pulse frequency in the cathode/anode circuit of UV tube 20. With a minimum signal of 10 hz, LED 67 flashes once in 10 seconds. With the nominal pulse signal of 250 hz, LED 67 flashes

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twice per second. For a ~~maximum~~ pulse signal of 500 hz, LED 67 is continuously illuminated.

Lockout circuit 40 provides for immediate closure of the fuel control valve 14 on occurrence of a pulse signal with a frequency greater than 500 hz, or other condition warranting that action. SCR1, when triggered, connects lockout relay CR1 across the low voltage supply, opening the contact CR1 between terminals 6 and 7, FIG. 4. This opens the power circuit to flame detector 33 of the combustion safeguard, closing the fuel valve 14, Fig. 4. Error LED 70 is energized providing a visual indication of the lockout condition. Energization of relay CR1 drains the charge from the low voltage filter capacitor C6. Concurrently the energization of error LED 70 drops the voltage at the base of Q1 to about 2.3 volts. The low voltage DC supply drops to 2.3 volts and FDCP 30, CPFS 31 and RSI 68 are inoperative.

Page 16, please amend the paragraph starting on line 9 and ending on line 13 as follows:

If signal terminal S1 should short to signal ground 22, the voltage across R9 is greater than 36 volts, the rating for zener Z10, which conducts, charging C17 through D13 and R35 to fire SCR1. Similarly, if CQ or RQ in the quench circuit 24 should short, S1 is effectively shorted to signal ground 22 through UV tube 20. Again, the voltage across R9 causes zener Z10 to conduct, firing SCR1 and initiating a lockout condition.

Page 17, please amend the paragraph starting on line 1 and ending on line 14 as follows:

The lockout circuit is actuated to close the fuel valve in the event the valve is open in the absence of a flame. Terminal 8, Fig. 4, is connected with the terminal of fuel valve 14 which is connected to power terminal L1. A current through R30 and C21 powers the opto 5 LEDs, turning on opto 5 transistor which connects the gate of SCR1 through R14 with the low voltage supply. If a flame is present, the signal potential at TP3 charges C13 through D8, causing Q7 to conduct and disabling the opto 5 transistor, preventing actuation of the lockout circuit. Should a flame be lost, the charge on C13 holds Q7 on for about 1.5 seconds, preventing a false lockout from a momentary flame fluctuation. The flame failure response time (FFRT), i.e., the time for a burner control to close the fuel valve when a burner flame goes out must not, by Federal law, exceed 4 seconds. The energy stored in capacitors C18, C19 and C20 injects only enough power with a 5 μ amp current to keep the valve open for 2 - 2.5 seconds. The total response time does not exceed 4 seconds; and the lockout circuit should close the fuel valve even faster. However, if the combustion safeguard should open the fuel valve when there is no flame, the lockout circuit is immediately actuated.

Page 21, please amend the paragraph starting on line 12 and ending on line 15 as follows:

The mechanical switch 84 as shown in Fig. 6 is intended to be illustrative. Other switching mechanisms, as solid ~~stage~~ state switches may be used. Alternatively, two DC power supplies, one positive with respect to ground and the other negative could be used, and electrode 75 switches between them.